How to Per form Y our Hydrology Investigation

Preparing For Your Hydrology Measurements

Selecting the Hydrology Study Site

Ideally, the Hydrology Study Site will be within a watershed that is a prominent feature in the 15 km x 15 km GLOBE Study Site. Within this watershed, select a specific site where the hydrology measurements (water temperature, transparency, pH, dissolved oxygen, alkalinity, electrical conductivity or salinity, and nitrate) will be taken. If there is a water body of special interest within your watershed, by all means choose that. Otherwise, the water bodies in order of preference are:

1. Stream or river
2. Lake, reservoir, bay, or the ocean
3. Pond

An irrigation ditch or other water body may be used if one of the above is not accessible or available within your GLOBE study site.

You should collect all water samples from the same place at the hydrology site each time. This is called the sampling site.

If the site is a moving body of water, like a stream or a river (*lotic*), locate your sampling site at a riffle area (a place where the water is moving but not too fast) as opposed to still water or rapids. If the site is a still body of water, like a lake or reservoir (*lentic*), find a sampling site near the outlet area or along the middle of the water body, but avoid taking samples near an inlet. A bridge or a pier are good choices. If your brackish or salty water body is affected by tides, you will need to know the times of high and low tide at a location as close as possible to your study site.

Site Description

Once you have selected your hydrology site, be sure to identify the coordinates of this site with the GPS receiver. Enter the location plus other site description information requested on the Hydrology Investigation Site Selection Data Entry Sheet. For the salinity protocols, you will need to know the latitude and longitude of the location for which you will report the times of high and low tide. You can measure these using a GPS receiver and following the *GPS Protocol* or obtain them from those who provide the high and low tide information.

Frequency

Collect all water-chemistry measurements at roughly the same time each day, on a weekly basis. If your sampling site freezes over in winter or runs dry, be sure to enter this information on the data sheet each week until you again have free-flowing surface water to measure.

Note: Certain times of the year provide more exciting measurements. When runoff is occurring on a river, the increased flow and sediment will dramatically change water-chemistry measurements. Just after ice melts off a lake is also a dramatic time because various layers of water in the lake are mixing with layers near or at the bottom of the lake. Often layers near the bottom end up on top near the surface, thus adding surprising changes to your measurement results. Be observant of seasonal and monthly changes.

Quality Assurance and Quality Control

A quality assurance and quality control (QA/QC) plan is necessary to ensure that test results are as accurate and precise as possible. Accuracy refers to how close a measurement is to true value. Precision means the ability to obtain consistent results. Reliability in both accuracy and precision is achieved by:

- Collecting the water sample as directed
- Performing tests immediately after collecting the water sample
- Careful calibration, use and maintenance of testing equipment

- Following the specific directions of a protocol exactly as described
- Repeating measurements to check their accuracy and to understand any sources of error
- Minimizing contamination of stock chemicals and testing equipment
- Checking to be sure the numbers submitted to the GLOBE Student Data Server are the same as those recorded on the Hydrology Investigation Data Work Sheet.

Calibration

Calibration is a procedure to check the accuracy of testing equipment. For example, to ensure that the pH instruments are functioning properly, a solution of known value is tested. Calibration procedures vary among the measurements and are detailed in each protocol. Certain calibrations must be done the same day as the field measurements. Some calibration procedures may be done in the classroom just before taking the equipment out into the field. However, in some cases, it may be necessary to check the calibration again in the field by doing a field measurement of a known value solution. See *pH* and *Electrical Conductivity Protocols*.

Promptness and Sequence When Making Measurements

Testing for transparency, temperature, and dissolved oxygen should be done on site (*in situ*) immediately after obtaining the water sample. Do not let the bucket of water sit for more than a half hour before taking measurements. Take a new sample if this happens. If unavoidable, samples may be bottled (see Bottling Technique in collecting your water sample) and tested in the classroom. However, we strongly recommend that all testing be done at the sampling site. We do not recommend doing the dissolved oxygen test in the classroom since the analysis should be done within 30 minutes of collection. Measurement of pH and nitrate (within 2 hours), alkalinity, electrical conductivity or salinity (within 24 hours) may be done later in the classroom if necessary.

Important: The sequence in which the measurements are performed is important. Transparency measurements should be taken first, followed immediately by the water temperature measurements and the dissolved oxygen test, then pH, electrical conductivity or salinity, alkalinity, and nitrate.

Important: Dissolved oxygen measurements have limited value unless the temperature of the water is known. Measure dissolved oxygen only if you measure water temperature. If your site is a salty or brackish water you also must measure salinity in order to interpret the dissolved oxygen measurements.

Repeated Measurements

Divide your class into at least two groups for each measurement. Once one group has finished their measurement, have them hand the equipment to the second group. Both groups use the same bucket of water for the measurement.

If the values found by the two groups differ significantly, the measurement should be repeated by a third group and perhaps repeated by the first two groups. The following are the maximum acceptable differences between measured values.

Measurement	Maximum Difference
Transparency	1.0 cm
Water Temperature	0.5° C
Dissolved Oxygen	0.4 mg/L (La Motte kit) 1.0 mg/L (Hach kit)
pH (using paper)	1.0 pH unit
pH (using pen or meter)	0.2 pH unit
Conductivity	2% of full scale (40 μS/cm)
Salinity (hydrometer)	0.4 parts per thousand
Salinity (titration kit)	0.4 parts per thousand
Alkalinity	4 mg/L as $CaCO_3$ (La Motte Kit) 1 drop (Hach Kit): 17 mg/L as $CaCO_3$ (high range) 6.8 mg/L as $CaCO_3$ (low range)
Nitrate	1.0 mg/L

Each group should use its own Hydrology Investigation Data Work Sheet. The value submitted to the GLOBE Student Data Server should be an average of all values obtained that meet the above criteria. Discard values that fall far outside the maximum differences. Note that for water transparency, all values should be submitted to the GLOBE Student Data Server.

Disposal of Liquid Waste

After tests have been conducted, all solutions (except for the nitrate analysis and salinity titration) and liquids should be collected in a wide-mouthed screw top plastic waste container and disposed of in a school sink or utility sink, and flushed with excess water. Or, they should be disposed of according to your local school district's safety procedure guidelines. The wastes from the nitrate analysis and the salinity titration (which typically contain cadmium and chromate, respectively) should be disposed of according to your local school district's safety procedure guidelines.